Age, Technology Usage, and Cognitive Characteristics in Relation to Perceived Disorientation and Reported Website Ease of Use

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ABSTRACT
Comparative studies including older and younger adults are becoming more common in HCI, generally used to compare how these two different age groups will approach a task. However, it is unclear whether user 'age' is the underlying factor that differentiates between these two groups. To address this problem, an examination into the relationship between users' age, previous technology experience, and cognitive characteristics is conducted. Measures of perceived disorientation and reported ease of use are used to understand links that exist between these user characteristics and their effect on browsing experience. This is achieved through a lab-based information retrieval task, where participants visited a selection of websites in order to find answers to a series of questions and then self reported their feelings of perceived disorientation and website ease of use through a Likert-scored questionnaire.

The presented research found that age accounts for as little as 1% of user browsing experience when performing information retrieval tasks. Further, it showed that cognitive ability and previous technology experience significantly affected perceived disorientation in these searches. These results argue for the inclusion of metrics regarding cognitive ability and previous technology experience when analyzing user satisfaction and performance in Internet based-studies.

Categories and Subject Descriptors
H3.3 Information Search and Retrieval: Search Process. H.5.2. User Interfaces – Theory and methods; J.4 [Computer Applications]: Social and behavioral Sciences – Psychology.

General Terms
Measurement, Human Factors.

Keywords
Older Adults; cognitive ability; HCI; web search; search strategies.

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1. INTRODUCTION
The UK Office of Communication (Ofcom) report that over 50% of adults aged 65-74 and 25% of those aged 75+ now have access to the World Wide Web [27]. With a growing number of adults using this technology comes a challenge in designing interfaces that this diverse population group can use. However, calling this cohort of users a single 'group' may cause problems - the methods and skills used by one of these users might well be completely different to that of another [16].

Differences have been found in the strategies used by older and younger adults in completing computer-based tasks [3, 7, 13]. Users' abilities can change greatly over time and these changes can differ depending on both the individual and the culture in which they live [15]. How important, then, is 'age' in determining the experiences that users' may have when searching online? Would metrics other then age perhaps provide richer information?

In this paper, we examine the use of age as a predictor of users' perceived disorientation and reported website ease of use. We report on a study in which older and younger adults participated in an information retrieval exercise to examine the perceived disorientation and reported website ease of use they experience. We then use multiple regression models to determine the suitability of users' age, cognitive characteristics, and previous technology usage in relation to these metrics. Perceived disorientation and reported website ease of use is obtained from participants through self-reported user data, relying on first hand participant information rather than inferred experience metrics that can be obtained through log-file analysis.

2. RELATED WORK
A wide body of work exists that examines the design needs of older adults. However, this can focus on a 'deficit model' attached to aging, concentrating on general declines in vision, reduction in working memory, and use of slower movements [23]. Such deficit models have been used to create 'age' based guidelines that recommend the use of bigger text, larger buttons, and simpler websites [19]. A problem exists in that 'senior-friendly' adaptions to websites assume that the changes made will then allow older adults to successfully use the Internet based on a standard set of age-based assumptions. This presents an issue, as older adults are a dynamic population with differing ability levels that can change highly between individuals.

Table 1 - Participant Internet and Cognitive Comparisons

Ability Measures	Younger Adult M	Younger Adult SD	Older Adult M	Older Adult SD	t(18)	Age Group Comparison (α = .05)
Age	22.12	3.18	73.66	9.11	-15.26**	YA < OA
Internet Usage	48.00	10.85	29.92	12.86	3.27**	YA > OA
Internet Confidence	54.88	12.59	44.25	13.38	1.78*	YA > OA
Fluid Intelligence	23.63	2.26	18.17	2.82	4.57**	YA > OA
Processing Speed	46.63	6.04	45.08	6.94	.511	YA ≈ OA
Short Term Memory	6.88	2.94	7.25	1.91	-.547	YA ≈ OA
Long Term Memory	13.75	5.34	14.92	4.76	-.512	YA ≈ OA

One of the most common alternatives to using age as a metric is to examine previous technology usage [7]. This can be measured using a variety of methods, with the most prevalent being user self-reported information. Possible implementations involve the use of questionnaires allowing users to report on aspects relating to technology usage, experience, and comfort. When examining the relationship between technology experience and task performance, older adults with high levels of previous technology experience have shown to have higher levels of performance in data-entry, file modification, and inventory management tasks than those with low levels of previous technology experience [6].

An alternative to user age that is more related to individuals' ability could be to examine their cognitive characteristics. One area of cognitive psychology that has shown to have promise in HCI surrounds fluid intelligence - the ability of an individual to adapt to a situation based on their problem solving skills [21]. Fluid abilities include aspects such as inductive reasoning, short-term memory, speed of processing information, and problem solving abilities. The process of aging results in many changes in cognitive abilities with fluid attributes diminishing as individuals get older [20]. These changes can have a profound effect on individuals' skill in understanding new technologies, and to efficiently carry out tasks. Technology, therefore, needs to be designed to optimize a person's capabilities, while also compensating for their weaknesses [17]. Differences have been found to exist in the search strategies used by older and younger adults, with younger adults relying on system interface features when searching while older adults rely on a broad range of features [3]. It is possible, however, that these 'age' differences between older and younger adults are related to other characteristics, as clear links have been drawn between demographic data, cognitive abilities, and computer usage [7].

Fluid intelligence has been previously used to examine user task performance although the results from this have been varied [4, 31]. A decline in fluid cognitive abilities has been shown to relate to a decline in the reformulation of information retrieval requests [10] – especially important when using search functionality on websites. Combined with fluid intelligence, other cognitive factors have been successfully related to task performance including processing speed, short-term memory, and long-term memory. These factors have been used both as a combined cognitive ability scoring [4, 5] and also as individual factors in their own right [12, 24, 26, 29, 34].

In this work, the roles of age, user Internet abilities, and cognitive factors in relation to user online satisfaction levels are explored. Firstly, chronological age is analyzed to determine its relationship to user browsing experience. Internet experience and Internet confidence are then included to understand if they can account for any additional variance. Finally, users' cognitive characteristics are included to examine the combined relationship between these factors and browsing experience. This work attempts to gain an increased understanding into the use of these Internet and cognitive based metrics when examining user browsing experience rather than user performance.

One of the most common problems faced by users when searching online it that of disorientation [25]. There are clear links between the methods used to navigate though a website and the tendency for users to lose their sense of location [33]. Many studies have tried to infer disorientation levels through the use of browser log information, rather than measuring users' feelings [1]. We use this second approach by gathering Likert scored data from participants within an information retrieval study. Sandelands and Buckner [28], among others, argue that the best method of gathering participant feelings is through quantitative responses and not qualitative work. We use this rationale to support this methodology.

3. METHODOLOGY

The main aim of this work was to consider how the inclusion of metrics other than chronological age could be used to enhance the understanding of how browsing experience can change between users when searching for information online. While previous research in this field has focused on user performance, we examined the effect that these factors have on overall browsing experience. Ethical approval for all areas of this work was obtained through a university ethics procedure.

3.1 Experimental Variables

Participant Age Group, Internet Ability (Internet Usage and Internet Experience), and Cognitive Measures (Inductive Reasoning, Perceptual Speed, Memory Span and Meaningful Memory) were used as independent metrics. Browsing Experience (Perceived disorientation and Reported Website Ease of Use) were used as dependent metrics.

3.2 Participants

Twenty participants were recruited for this study. This consisted of 12 older adults (*M* = 73.66, *SD* = 9.11, *Range* 63-90) and eight younger adults (*M* = 22.12, *SD* = 3.18, *Range* 19-29). Older adults were recruited from a pool of potential participants in the local area that had previously expressed interest in taking part in academic studies, being contacted by the user pool coordinator through either phone or e-mail. Younger adults were recruited through e-mail and university message boards and then added into the user pool database. All clarified in pre-screening that they had not taken part in any HCI research studies in the past 12 months.

Table 2 - Participant Testing Battery Information

Measure	Ability Tested	Description
Letter Sets Test [11]	Fluid Induction	Participants determine which of four letter sets is unrelated to the others
Meaningful Memory Test [2]	Long Term Memory	Participants given a list of objects to study and then asked to select similar words after a 10 minute break
Number Comparison Test [11]	Perceptual Speed	Participants required to inspect pairs of large numbers and indicate if they were the same or different
Auditory Number Span [11]	Short Term Memory	Participants were read random-number sequences and asked to repeat each sequence.
Internet Usage Questionnaire	Internet Usage	19-item questionnaire assessing participant Internet Usage
Internet Confidence Questionnaire	Internet Confidence	16-item questionnaire assessing participant Internet confidence

3.3 Materials and Equipment

Demographic Information —Demographic information including participant age, education and occupational status were collected from participants through a questionnaire.

Internet Ability—Two questionnaires examining participant Internet Ability were used. The first of these examined participant Internet *Confidence* and consisted of 16 questions. These questions asked participants their confidence in completing a number of Internet based tasks, measured on a 5-point scale (Strongly Agree, Agree, Neither Agree nor Disagree, Disagree, Strongly Disagree). The second examined participant Internet Usage and consisted of 19 questions. These questions asked participants how often they would complete a number of Internet based activities and was measured on a 7-point scale (Everyday, Several Times a week, Several Times a month, Every few months, Less Often, Never).

Cognitive Measures—Four cognitive measures were used to gather information on a subset of individuals' abilities. This consisted of the Letter Sets Test (measuring fluid induction) [11], Number Comparison Test (perceptual speed) [11], Meaningful Memory Test (long-term memory) [2], and Auditory Memory Span (memory span and working memory) [11]. Summary Information on *Internet Ability* and *Cognitive Measures* are found in Table 2.

Browsing Experience—A questionnaire based on work by Ahuja and Webster [1] was used to gather information on users Perceived Disorientation and Reported Website Ease of Use. This questionnaire was designed to measure perceived disorientation and participant reported 'website ease of use' during online tasks and has been widely used since its introduction [18, 22, 32]. This questionnaire consisted of 10 questions, measured on a 7-point scale (Strongly Disagree, Disagree, Somewhat Disagree, Neither Disagree or Agree, Somewhat Agree, Agree, Strongly Agree).

Task Question Set— 30 questions were created that prompted users to create a path through a website in order to complete an information retrieval task. These questions were created based on 30 individual websites that were selected for inclusion in this study. One question was created for each website. Twenty-five of these sites were selected from the top 100 visited websites in the UK (according to Alexa[1]), split into five categories: health, shopping, news, governmental, and banking. Five additional websites were also selected that included information on attractions in the local area. Each task required participants to visit between two and five pages on the optimum path. However, the number of pages participants would visit increased if they used an alternative route.

Experimental Equipment—The experiment ran on an apple laptop computer (Macbook Pro Mid-2010[2]), with the Google Chrome Browser being used. The laptop was placed in front of the researcher and the participant was given control through a 22" Widescreen Monitor, and a standard Microsoft Keyboard and Mouse. Monitor display was mirrored between the laptop and the additional monitor. Control of the experiment was achieved through a tablet device handled bit the researcher. This allowed the researcher to see the current question that is being asked, and additionally navigate through questions to control the flow of the study

3.4 Procedure

Participants were firstly invited to take part in a group session in order to gather data on their *demographic information, Internet Ability,* and *Cognitive Measures.* Four separate sessions were used allowing for participants to be split into smaller, more manageable groups. Younger adults were tested separately to older adults.

After completing the testing battery, participants were then invited to take part in a second individual session where they completed a number of information retrieval tasks taken from the *Task Question Set*. Once an individual question was completed, participants were given the *Browsing Experience* questionnaire to complete relating to the information retrieval task that they had just completed. Task order was randomized between participants in order to reduce ordering effects.

3.5 Analysis

An initial analysis of the two age groups (younger and older adults) showed differences between participants' Internet usage, Internet confidence, and Inductive Reasoning. No age-related differences were noticed regarding perceptual speed, memory span / working memory, or meaningful memory. This was unexpected, as previous literature has shown that these metrics deteriorate with age and differences should be seen between these two groups [20].

A possible explanation (and limitation), can be explained in the educational background of the older adults recruited for this study. 9 of the 12 (75%) older adults reported education of Bachelors

[1] http://www.alexa.com/topsites/countries/GB

[2] http://support.apple.com/kb/SP584

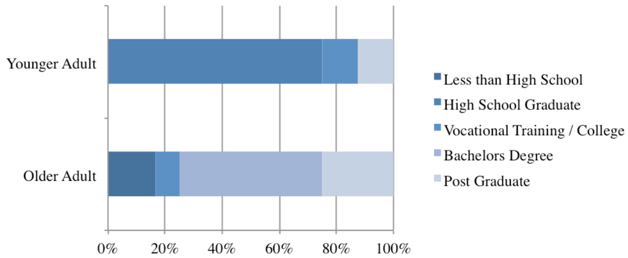


Figure 1 Participant Education Background Summary

Degree or higher, with previous literature showing a link between educational background and these characteristics. This is detailed in Figure 1.

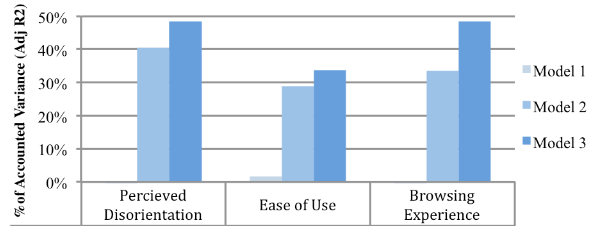
Analyses was designed to determine the impact that Age, *Internet Ability*, and *Cognitive Measures* had on understanding the *Browsing Experience* of this population. This was done to discover if any additional variance could be uncovered by examining Internet and Cognitive factors on top of that discovered between age groups. Multiple regression was therefore used to analyse the data. Cognitive Measures, Internet Ability, and age were split into three separate models during analysis. Cognitive Measures and Internet Ability were normalised by dividing individual participant metrics by two times of the group standard deviation and age groups coded as a dummy variable (Younger Adult = 0, Older Adult = 1). This method, suggested by Gelman [14], allows for a direct comparison between scalar and binary predictors.

In Model 1 only participant age was included as a measured variable. Model 2 expanded on this by including *Internet Ability*. Model 3 contained all *Cognitive Measures* along with the metrics outlined in Models 1 and 2. The three regression models were performed consecutively, with additional metrics being added with each analysis.

Three multiple regressions were performed in total, the first focussing on participants' perceived disorientation, the second on reported website ease of use, and the third on a combined *Browsing Experience* score.

4. RESULTS

When examining the effectiveness of metrics to predict a user's disorientation and website ease of use, the results gathered indicate that age cannot be used as a metric to understand feelings of disorientation or website ease that occur when carrying out an information retrieval task. In Figure 2, Model 1 represents the variance accountable for only age. When examining the models, age cannot account for any variance present when analysing user perceived disorientation or users overall browsing experience. Age was only able to predict 1.6% of any variance when examining user feelings on a websites ease of use. As previously stated, the younger and older adult were coded as 'dummy' variables in analysis, and while using these two dichotomous groups is a limitation in this work as it may over inflate any results comparing these two groups, the results show that only a very small amount of variance regarding users browsing experience can be explained by the differences between these two age categories. This provides initial evidence to support the objectives set out in this paper – examining the extent to which age accounts for variance in user satisfaction when completing information retrieval tasks. Similar results are reported by Czaja et. al [7] who found that including age within the final step of a



	Percieved Disorientation	Ease of Use	Browsing Experience
Model 1	-0.6%	1.6%	-2.3%
Model 2	40.5%	28.9%	33.6%
Model 3	48.4%	33.7%	48.5%

Figure 2 Regression Model Comparison Summary

regression analysis did not significantly help in predicting individuals' technology usage.

Model 2 improves on Model 1 by including participants' previous Internet usage and Internet confidence. This created a noticeable improvement in the amount of perceived disorientation accounted for between groups with this increasing to 40.5%. This indicates that it is possible to understand more about why an individual may feel lost completing information retrieval tasks by examining their previous experiences and confidence in using the Internet rather than relying on their age. Similarly, users feelings of website ease of use increased to 28.9% and their combined browsing experience increased to 33.6%. The inclusion of cognitive characteristics in Model 3 again provided an increase in the amount of variance accounted for, with perceived disorientation of participants improving a further 7.9% to reach a total of 48.4%. While the increases seen between Model 2 and Model 3 may not seem significant, the reason for this is the order in which these variables were placed into the regression. A high percentage of regression overlap appears between these variables, and therefore accounts for the small increase in accounted variance.

A summary of regression analysis participant perceived disorientation is detailed in Table 3. Age as a single factor accounted for a very small amount of variance (Adj. R^2 = -.006) with the addition of technology factors causing an increment in

Table 3 Multiple Regression Model - Perceived Disorientation

	B	SE B	β
Model 1			
Constant	1.795	.155	
Age	.189	.200	.217
Model 2			
Constant	3.276	.425	
Age	-.168	.197	-.194
Internet Usage	-.238	.202	-.272
Internet Confidence	-.552	.174	-.632**
Model 3			
Constant	4.310	1.267	
Age	-.188	.292	-.216
Internet Usage	.021	.220	.024
Internet Confidence	-.646	.177	-.740**
Fluid Induction	-.051	.242	-.059
Perceptual Speed	-.404	.170	-.462*
Short Term Memory	-.063	.190	-.072
Long Term Memory	.359	.201	.411

Note: Adj R^2 = -.006 for Step 1, Adj R^2 = .405 for Step 2 (p < .01), Adj R^2 = .484 for Step 3 (p < .05).

$^*p < .05$, $^{**}p < .01$, $^{***}p < .001$.

Table 4 Multiple Regression Model - Ease of Use

	B	SE B	β
Model 1			
Constant	3.060	.115	
Age	-.170	.148	-.261
Model 2			
Constant	2.153	.348	
Age	.033	.161	.051
Internet Usage	.092	.165	.141
Internet Confidence	.381	.142	.583*
Model 3			
Constant	1.044	1.075	
Age	.144	.248	.221
Internet Usage	-.103	.187	-.157
Internet Confidence	.447	.151	.683*
Fluid Induction	.186	.205	.284
Perceptual Speed	.285	.144	.437
Short Term Memory	.019	.161	.029
Long Term Memory	-.260	.171	-.398

Note: Adj R^2 = .016 for Step 1, Adj R^2 = .289 for Step 2 ($p < .01$), Adj R^2 = .337 for Step 3 ($p < .05$).

$*p < .05$, $** p < .01$, $*** p < .001$.

Table 5 Multiple Regression Model - Browsing Experience

	B	SE B	β
Model 1			
Constant	1.177	.123	
Age	.120	.159	.176
Model 2			
Constant	2.258	.354	
Age	-.129	.164	-.188
Internet Usage	-.134	.168	-.195
Internet Confidence	-.435	.144	-.632**
Model 3			
Constant	3.920	.998	
Age	-.281	.230	-.411
Internet Usage	.064	.173	.093
Internet Confidence	-.518	.140	-.752**
Fluid Induction	-.212	.190	-.307
Perceptual Speed	-.370	.134	-.538*
Short Term Memory	-.068	.149	-.099
Long Term Memory	.248	.158	.361

Note: Adj R^2 = -.023 for Step 1, Adj R^2 = .336 for Step 2 ($p < .05$), Adj R^2 = .485 for Step 3 ($p < .05$).

$*p < .05$, $** p < .01$, $*** p < .001$.

Adjusted R^2 to .405. The addition of cognitive factors increases the Adjusted R^2 by an additional .008 to .484. In this final regression, it was found that key components, which correlated with perceived disorientation, were Internet confidence and processing speed.

These results suggest that when examining the amount of disorientation that is reported by an individual when carrying out an information retrieval task similar to the ones used in this work, a large amount of variability between participants is down to their confidence in using the technology, and also their perceptual speed levels.

Summary analysis for reported website ease of use is presented in Table 4. Similar to perceived disorientation, age again accounted for a very small amount of variance (Adj R^2 = .016) with the addition of technology factors increasing Adjusted R^2 to .289. The attachment of cognitive factors increased Adjusted R^2 to .337 with Internet Confidence being the only significant factor present in the model.

This again suggests that when examining how easy users find a website to use, a large amount of variability exists due to user confidence in the technology. No significant results were found regarding user age, suggesting that the age group a user is in has very little to do with how easy or difficult they find a website to navigate around.

The final regression analysis collated the dependant measures into a single scoring, containing reported website ease of use and perceived disorientation. In this model, summarized in Table 5, age produced an Adjusted R^2 of -.023. This increased to .336 when including technology factors and again to .485 when including cognitive factors. In this final model, Internet Confidence and Processing Speed were seen to be significant factors.

Similar to a measure of only user perceived disorientation, this suggests that individuals' browsing experience is heavily influenced by their confidence in using technology, and not the overall amount of usage that they may report. Additionally, individuals' perpetual speed has shown to have an effect on the overall browsing experience, while age category does not have any effect.

5. DISCUSSION

In the analysis, the main factors that could be used to predict levels of perceived disorientation in users were their confidence in using the Internet and also their perceptual speed. Figure 3 shows coefficients (*B*) for reported disorientation complete with 95% confidence intervals (an increase in value of 1 from any of the given metrics leads to a related change indicated by the bars, with 'error bars' indicating confidence that 95% of results would be between the two limits). This chart indicates that higher levels of Internet confidence and processing speed lead to reductions in perceived disorientation. From this, it can be inferred that an increase in confidence in using technology has a direct correlation on feelings of low perceived disorientation when completing information retrieval tasks online, with similar results appearing with their processing speed. An interesting point to note here is that no meaningful correlation was found between the amount of previous experience that an individual has in using the World Wide Web and any feelings of perceived disorientation. Significance is placed more on the confidence in using technology.

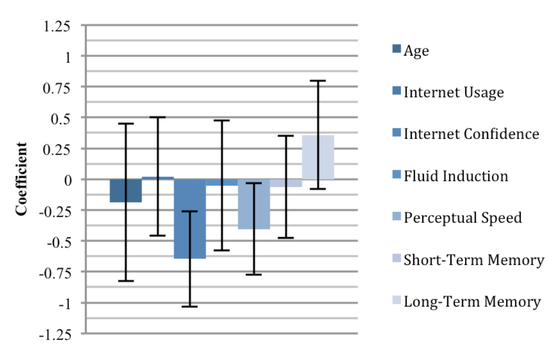


Figure 2 Coefficient for Perceived Disorientation with 95% Confidence Intervals

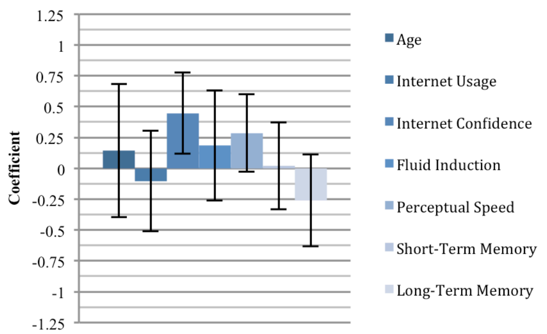


Figure 4 Coefficient for Ease of Use with 95% Confidence Intervals

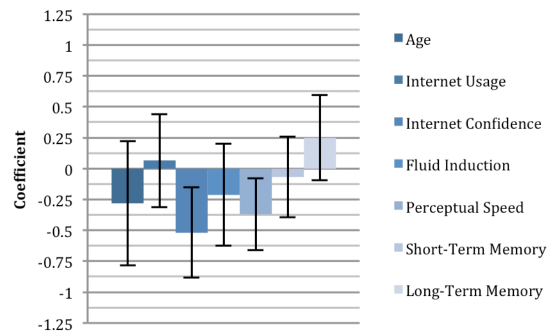


Figure 5 Coefficient for Browsing Experience with 95% Confidence Intervals

A slight difference was found when examining the reported website ease of use of participants (shown in Figure 4). It was found that only Internet confidence played a significant part in determining whether a website was easy to use when performing information retrieval tasks. All other metrics had 95% confidence intervals which spanned both sides of 0, indicating that they could not accurately determine whether they may have a positive or detrimental effect on the reported ease of use of a website.

Combining perceived disorientation and reported ease of use into one metric examining overall browsing experience creates results similar to that of perceived disorientation, with both Internet experience and perceptual speed producing significant correlations (shown in Figure 5). No other factors contributed significantly in this model. This indicates that when examining the overall browsing experience of an individual when completing information retrieval tasks, a large amount of variance can be accounted for by again focusing on the previous confidence that a user has in using the Internet, and also the mental quickness that is attached to levels of user perceptual speed.

It was found in all three of the regression models that individuals' Internet confidence can account for a large amount of the variance that is associated with the perceived disorientation, website ease of use, and overall browsing experience of individuals when completing information retrieval tasks. Additionally, it was found that individuals' perceptual speed could influence their perceived disorientation and overall browsing experience. However, in all cases, age was unable to account for any variance and could not be used to predict any aspect of users browsing experience when completing this study.

User age has a very small effect when predicting users' browsing experience. All regressions in this study reported that age could not account for a significant amount of variance that is attached to participant perceived disorientation, reported website ease of use, or overall browsing experience. As such, one of the key findings from this study, and a recommendation for future HCI work, is that age cannot be used as a grouping variable when examining the browsing experience of individuals.

Internet Confidence, rather than Usage, is important in predicting browsing experience. While the amount of usage that individuals have in using a particular technology may increase their speed at completing tasks, the finding in this work suggests that it is their *confidence* in using technology that has an impact in their overall browsing experience. It is therefore suggested that a possible method of increasing the browsing experience for users is to attempt to invoke feelings of confidence in a system or service from an early stage, in order to make users feel more comfortable in using them.

Inductive Reasoning did not show to be a predictor of Browsing Experience. A surprising outcome from this work surrounds inductive reasoning, and its inability to act as a predictor of browsing experience. A large amount of literature in the past has examined fluid intelligence as a predictor of user performance, and Inductive reasoning is one of the 3 sub-abilities in this measure. This work found that while higher levels of inductive reasoning pointed towards less participant disorientation and a higher ease of use scoring, this was not at significant levels. A possible reason for this may be down to this work using a more subjective measure of performance, and that measures such as inductive reasoning are more key in objective performance metrics such as task completion time.

Perceptual Speed showed to be a predictor of Browsing Experience. The processing speed sub-ability, perceptual speed, was successfully used as a predictor of user browsing experience. Higher levels of perceptual speed, resulted in lower levels or perceived disorientation, high levels of reported website ease of use, and higher levels of overall browsing experience. This findings suggests that the mental quickness that is associated with this ability, can be utilized in order to quickly understand links between information retrieval questions, and the possible routes through a website. However, caution must be applied, as high levels of processing speed have been shown to correlate with high education levels in an individual, and this may in turn produce a secondary effect.

6. CONCLUSIONS

This paper has provided evidence that age is not a suitable metric to distinguish between users. Factors such as previous Internet usage and cognitive abilities can illuminate more significant contributors to ease of use than age alone. The primary finding to emerge from this study is that cognitive factors can be used to account for a substantial amount of variance within both older and younger adults, with factors acting as both negative and positive influencers. While this has been examined before regarding user performance [8, 9, 30], we have shown that similar results can be obtained when using hedonic measures such as search experience. This further demonstrates the ability of cognitive metrics to provide reasoning into how users interact with technology.

We have also shown that Internet experience metrics can be used to aid in understanding user disorientation, with an emphasis placed on users' Internet confidence rather than Internet usage. Complementing this finding, we have also shown that the amount of confidence that an individual has in using the Internet results in an increase in perceived disorientation in younger adults, but a decrease in disorientation in older adults.

Additionally, we have also demonstrated that differences between older and younger adults confidence in using technology can effect their overall disorientation in different ways. Older adults with high Internet confidence showed a reduction in perceived disorientation, while younger adults with high Internet confidence showed an increase in perceived disorientation. This clearly highlights the differences in behavior between these two generations of technology users.

A key implication for research practice arising from this work surrounds the use of participant age as a grouping variable within future research studies. This work has shown that age cannot be used as a suitable metric to distinguish between individuals when examining their browsing experience, and as such, further questions must be asked regarding its usage as a suitable metric when distinguishing between individuals in both the HCI and User Experience fields. It is suggested that while age can be used to distinguish between different generational groups, and this may be beneficial in study design, analysis should consider alternative metrics such as participant confidence in using the technology or service being tested. This method may provide additional information into reasoning's surrounding the experiences of individuals before assuming that age based differences occur.

Additionally, and of importance when examining cognitive abilities, the work in this paper has shown that subjective measures, such as perceived disorientation and browsing experience, can be used as alternative measures to understand user performance rather than relying on objective measures such as task completion time. This finding may have wider implications in the user experience domain as with a move to subjective based metrics, it is possible adapt methods to allow quantitative user experience experiments similar to those used in the HCI domain in general.

It was also found that Internet confidence is a key measure in accounting for the perceived disorientation, reported website ease of use, and overall browsing experience of an individual. This has implications for future user training, as it could be viewed that a focus on increasing the confidence that individuals have in using a particular service will increase their overall experience in using it. This approach, as opposed to providing users with information on how all aspects of a system works, may provide individuals with a higher level of satisfaction, improving their experience in using a service and in turn may also increase technology retention rates.

From these results, we recommend that users' cognitive factors and Internet confidence demographics should be used within the analysis of online activities, rather than relying on user age. We have demonstrated that when examining the experiences felt by users, age is a very limited metric in terms of developing an understanding of why users are reporting feelings of disorientation and ease of use. A much greater understanding can be achieved by including cognitive factors and Internet based demographics.

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